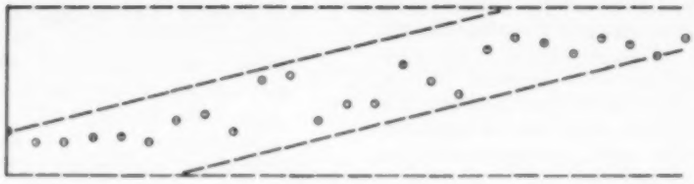
INDUSTRIAL QUALITY CONTROL



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THE SOCIETY OF QUALITY CONTROL ENGINEERS

NATIONAL ORGANIZATION

A score or more letters have reached the editor's desk in recent months inquiring about the prospects for a national society of quality control engineers. An even greater number of verbal inquiries have been made by members of the Society at Buffalo. These inquiries are in a sense evidence of an active demand for a national society. There is reason for believing that they are a small but representative sample of a generally felt need among quality control operators in industry.

The potential membership for a national quality control organization cannot be foreseen completely although some areas are clearly defined. Within the past two years the Office of Production Research and Development of the War Production Board has trained in the intensive eight day courses at least 1200 persons. Simultaneously, several thousand have been trained in part time courses offered through the Engineering, Science, Management, War Training Program of the United States Office of Education. Many more have been trained in tuition courses offered by Universities and Technical Schools. Beyond these areas of formal training lies the unknown segment. Thousands of companies are using quality control techniques that have been developed by men who perhaps read some books but who in the main have acquired their knowledge by word of mouth through attendance at scientific meetings or through visits to plants using control methods. Most of this growth in usage takes its origin from the pioneer work of Western Electric, Westinghouse, General Electric, The Bell Laboratories, and many other concerns whose contributions, although equally important, have received less public recognition.

Industrial Quality Control as an integral part of the American production system is not a dream for the future; it is an accomplished fact. The speed with which this tool of management has made its way into the system is the best evidence of its soundness. The character of the men and women who are applying quality control procedures is the best guarantee of stability and future expansion. But these operators, many of them having entered the field within the past year, need the assistance that can be made available only through an organization devoted solely to their interests: an organization that will have as its primary aim the establishment in the collective industrial mind of the importance of quality control in the industrial system.

A national organization cannot be started by fiat. The launching of a venture of this importance must be preceded by careful planning. Two major elements of such preparation would seem to be: (1) to bring into consultation as many as possible of the leaders in the field, (2) to make all plans revolve around the central theme that the national organization will stand or fall on its ability to offer service to the rank and file of quality control operators.

An organization whose chief strength lies only in the obligation which members may have to the national leaders is not strong, because the membership will disintegrate as the sense of obligation dwindles. An enduring national organization must be founded on the service principle. That is, the benefits to be derived from membership must be such that quality control operators cannot afford to miss those advantages. This raises the question of what the detailed program of a national organization should include. Some of the indispensables are: a medium of printed contact, proper reciprocal relations with local constituent societies, sectional and national meetings to supplement local meetings, a representative form of management, leadership at the top.

Perhaps the most important post that could be created would be an educational director. His task should be to encourage officers of local associations to take the lead in setting up training courses of two kinds: (1) those designed for training new operators usually offered through the colleges and universities, (2) short refresher courses or seminarys designed to keep present operators abreast of newer developments. The latter might be managed by the local society or by the society and a local educational institution jointly. The object of the first type of course would be to spread the use of Quality Control and simultaneously to insure a constant flow of new members into the society. The object of the second would be to weld together the existing members by acting as the catalytic agent through which they become more effective in their profession.

Quality Control will be a powerful force in the postwar period. A national quality control organization properly launched and unanimously supported can do much to direct that force and make control procedure a recognized part of management technique.

INCREASE IN SIZE

With this issue the size of Industrial Quality Control is being increased from 16 to 20 pages. The change is made for two primary reasons: the response to previous issues from Quality Control operators at home and in other areas; the amount of material steadily flowing to us for publication from all over the country. Even with four additional pages available, some selection of material will be necessary because part of the added space will be devoted to news notes and announcements of meetings, matters which have been partially neglected in earlier issues.

APPLIED QUALITY CONTROL

Andrew I. Peterson
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QUALITY IN GENERAL. Quality is everybody's business in a manufacturing plant. The introduction of Statistical Quality Control is insurance against quality becoming nobody's business. The quality engineer is specifically responsible for the maintenance and improvement of quality and he is equipped with the technique needed to do the job.

Maintenance and improvement of quality has always been the goal of management. This is the essence of industrial progress, and is the obvious product of the whiplash of private competition. In the past, the implementing of this objective has frequently been inefficient and often has missed the objective altogether. Information has simply not been available on which to base action designed to give a quality level which is economical from the manufacturing point of view and which conforms to marketing requirements.

Most firms include in their organization charts a quality department However, the plant functions performed by such departments vary widely, in some cases being identified with routine inspection operations, in others being responsible for the writing of procedures for the guidance of both inspection and production, in still others being in direct charge of policing conformance to written procedure, and in a few cases being purely advisory to management with only indirect access to operating supervision. This divergence in function of quality departments has been reflected in variable practice in the tasks assigned to quality control divisions.

DYNAMIC QUALITY CONTROL. In some plants quality control means conventional acceptance screening inspection, perhaps including records whereby defects can be allocated sooner or later to particular inspectors or operators. In other cases the term applies to complaint investigations and their follow up. Some consider the superficial forms of patrol inspection to be quality control, but they rarely make efficient use of the control information provided by the inspection. In contrast to these usages is management's employment of control technique in the dynamic sense. It is directed at the prevention of defects and unnecessary variability in process factors, rather than primarily at acceptance inspection of parts and products after defective material has been produced. The preventive technique consists in continuous study of process variability to discover the long run characteristic pattern of process variables and product in terms of conformance to specifications with emphasis on drawing dimensions and tolerances. Armed with this knowledge the quality control engineer is in position to detect the onset of assignable causes of variability and characterize the attainable performance of the process. Prompt recognition accompanied by equally prompt corrective action is the essence of dynamic quality control. Without corrective action both control and quality fall short, and control action as well as the quality department become sterile overhead expense.

The control of quality through the application of statistical techniques to manufacturing operations introduces precision in an area that needed improvement. Particularly during the war period there has been tremendous emphasis on quantity. Inevitably the drive for quantity must be to some extent at the expense of quality. But the quality control engineer has been able in many plants to maintain the balance between quality and quantity by means of statistical analysis of production from the point of view of process variability, its causes, and control.

CONSEQUENCES OF LACK OF CONTROL. To maintain confidence and value, manufacturing must take one or both of two precautions: (a) fully and reliably screen out non-conforming parts and products all along the manufacturing line; (b) control the variability of product characteristics at source to a degree where the risks of finding non-conforming elements are economically low.

Complete screening inspection of all parts and products is costly; with destructive testing it is impossible. In fact, 100% inspection is not sufficient with some critical characteristics. Some defects always get through. Complete protection develops only with control

well within specification limits. With single-limit specifications, control permits averaging closer to a limit, with consequent economy in the use of factors of production.

However, despite complete screening and shipment of only acceptable quality, excess variability and instability along the production line must result in unnecessary scrap, rework, reduction in capacity, and disruption of schedules. Obviously, quality shrinkage reduces effective supplies of labor, material and tools.

ADVANTAGES OF CONTROL. The costs of poor control and elaborate screening jeopardize the competitive position of a manufacturer. Good control opens the margin between cost and price, and indirectly improves and stabilizes the related control of production volume, sales, purchases, and costs. In summary, the advantages of good quality control have been found by representative manufacturers to be:

1. Reduction of the costs of scrap, rework, and adjustment.

2. Reduction in the costs of the factors of production through random assembly, uninterrupted production, and greater utilization of labor and facilities.

3. Reduction in costs of inspection.

4. Improved attainable quality standards, with either higher market values for a given sales volume, or greater volume for a given price.

5. Lower cost designs of products and processes for a given product quality standard.

6. Improved technical knowledge, more reliable engineering data for product development and manufacturing design, and reliable characterization of the attainable performance of processes.

THE QUALITY CONTROL PROGRAM. The practical significance of the science of quality control has been well established by representative manufacturers. Some managements have been reluctant to adopt the methods, however, despite interest developed by some of their men; perhaps through failure to understand them. Or this may be due to managerial fears that wholesale and problematic changes in operations are necessary.

First, it must be recognized that modern quality control is a specialization of production engineering, involving basic scientific method. Much has been written of the purely statistical aspects of control which are basic to any competent understanding. But the methods are tools, like trigonometry and chemical analysis, to correspond to the relative importance of each problem. With a product of simple design, exacting specifications and relatively high unit value, illustrated by the ball-bearing, the expenditure of as much as a third of direct labor effort on statistical control methods is justified. However, with a product of relatively low precision requirements, assembled from semi-finished components of relatively low unit value, illustrated by a lamp socket, the simpler direct inferences from routine inspection data may suffice.

The emphasis of modern control science is upon economic and systematic ways of supervising variability and its causes. The thinking must be statistical, but the techniques may be simple. The control chart is simple, but of tremendous importance. It can be used in isolated problems on a single machine or process, with little effort and training.

However, those who have seen modern quality control in its ultimate development realize that the current problem is one of industrial education in approach and technique. The growth of work simplification provides a parallel. Correspondingly, programs of development and realignment should be applied gradually, allowing specific methods to adapt and to sell themselves fairly at each stage. Perhaps the following steps can be suggested:

1. *Preparatory and Educational Period*

1.1 Acquisition of familiarity with control charts and other elementary statistical technique by one or two key process engineers.

1.2 Application of control charts to one or two simple problems, say at existing inspection points.

1.3 When successful, extension of technique to other problems in the same department, using experience of original inspectors.

2. *Formative Period*

2.1 Set up steering committee for new methods, representing engineering, production and inspection.

2.2 Explain techniques and results obtained in preparatory experiences.

2.3 Make a survey of critical quality and high scrap loss areas, presenting quality loss dollars where they originate.

2.4 Select a few new critical problems

(Continued on Page 12)

GROWTH OF A QUALITY CONTROL DEPARTMENT IN A CANADIAN AMMUNITION PLANT*

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Statistical Quality Control as an instrument of industrial management is comparatively new in Canada which, I believe, is also true in the United States. Accordingly, as is the case with any new development, we have been confronted with the problem of the relation of the new to the old. Specifically, the question is, "How should a Statistical Quality Control Section fit into the average plant organization?" Tonight, I would like to tell you of the answer to that question which experience has given us in the Canadian Shell Filling Plants. This answer probably will not fit into your plants, but perhaps some adaptation of it will be of use to you.

First - there are certain unique features about our Shell Filling Plants which need to be stressed as a background to this discussion:

1. The plants produce a large and ever changing variety of products.

2. These products require a large number of different components most of which are purchased from outside supplies.

3. The ammunition designs are in general based on British designs, but, normally, they require adaptation to Canadian practice.

4. The products are inspected by an outside source through the various stages of their manufacture. Effectively, there are four outside sources operating more or less independently on the inspection of shells, cartridges, fuses and explosives.

This last point was the real cause for our interest in Statistical Quality Control. Since the inspection was in the hands of others, it was most difficult to convince production people that the responsibility for quality was theirs. The tendency was to push the production through, right or wrong, and then argue with the inspectors later. This situation, in some cases, was permitted to get out of hand, the result being bad relations between production and inspection, each of whom felt the other was responsible for quality and the waste of Government money due to rejected material.

Another effect of this attitude was an increase rather than a decrease in the amount of inspection as production improved. It was felt by the Managements of the plants that the amount of inspection was excessively large when compared to the results obtained.

As a first cure for this situation, an attempt was made to institute plant inspection responsible to Management and acting between production and the outside inspection. The idea was to put the responsibility for quality back in the hands of the plant with the hope that, eventually, the quality would so improve that the total amount of inspection both plant and outside, would be less than formerly. It was soon seen, however, that the situation required more drastic action.

Statistical Quality Control was suggested as an alternative. This form of the control of quality was already in successful operation in Canadian small arms ammunition plants where the large machine production made the principles ideally applicable. However, it was felt that some of these principles could be very usefully applied to the small hand production in the shell filling plants. The Management therefore appointed a Senior Superintendent to be in charge of Quality Control. This position was of equal rank with that of Senior Superintendent in charge of production. The decision as to the rank was the subject of a considerable amount of discussion as it has been at various other plants, no doubt including many of your own. That it was a wise decision is borne out, I believe, by the results obtained to date. It was based on the concept that the control of quality must lie in the hands of production, but that the authority as to the grade of quality produced must lie in the hands of an unbiased observer.

For successful operation of such a set up, this concept must be carried still further. The decisions of the Quality Control Department with regard to quality must be upheld by Management, right or wrong. Naturally, Management cannot overlook many wrong decisions, but the answer, in that case, is a change in

*A paper presented at the October 9th dinner of the Society of Quality Control Engineers.

personnel - not a change in authority.

The usefulness of a Quality Control group can be eliminated very easily by just one adverse decision.

A Quality Control Superintendent was appointed in March of 1943. A little more than a year later, the Department had grown beyond recognition. The final organization has proved so successful that it has now been adopted by all other shell filling plants in Canada. The department's responsibilities include a good many services which are not strictly Quality Control, but yet, the whole thing fits together so naturally with Quality that the name of the department has not been changed. Now, let us look at this organization.

Depending upon the size of the plant, the Superintendent has one or two Assistants. Reporting to them are five Supervisors in charge of Quality Control, Development, Methods and Process Control, Chief Chemist and Manuals and Plant History.

The Quality Control Supervisor has, reporting to him, two sections - one called Materials Control and the other called Statistical Quality Control. Materials Control, which works closely with the Production Planning Department, carries out inspection of incoming materials, investigates material defects, compiles usage figures and investigates abnormal wastage.

The Statistical Control Supervisor has beneath him, the complete statistical set-up which I wish to describe by itself a little later on.

The Development Supervisor is responsible for the development of methods for handling all new products and for any development work required in the way of improvement of present methods as suggested by the Production Department or by the Methods or Statistical sections. In this section also are handled all drawings and specifications, of which there are thousands in such plants. From the designs which are supplied, they compile factory specifications to govern production. This, in many cases, involves a considerable amount of negotiation in order to obtain concessions to fit Canadian plant practice.

The Methods & Process Control Supervisor is responsible for the posting of standard operating instructions and for the study and improvement of existing operations, where possible. He works closely with the Statistical section and the Development section.

The Chief Chemist is responsible for the inspection of incoming chemicals and explosives, for the chemical control of the plant's use of these materials and for the development of new methods involving them.

The Process Manuals and Plant History Supervisor's responsibilities are self evident.

With this bare outline of duties, I hope that you can see that this Quality Control Department has in its hands every tool necessary not only for the maintenance but for the improvement of quality. It can control all incoming materials, the methods followed in production, and the quality of the final product.

Such a department relieves the Production Department of a great deal of work for which they seldom have time and centralizes the technical help in a plant in such a way that it is readily available as a service for the entire plant. The result has been a most evident improvement in quality, a return of the responsibility for quality to the production department and a return of cordial relations with outside inspection.

Now, since most of you are mainly interested in the Statistical Method of Quality Control, I would like to outline briefly the functioning of that section, and conclude with an example or two from our records.

Throughout the period of operation of the Quality Control Department, inspection has been done by Government Inspection. This inspection in general was 100% and was made at several points during the manufacture of each product. At each of these points, it was possible for the statistical section to obtain a running record of the fraction of defective material. Thus it was never necessary for this section to do its own inspection. The 100% inspection results provided were plotted as being a sample of the quality produced by the process. Ordinarily, these results were gathered each hour and plotted on wall charts in full view of production operators. All inspection of ammunition is of the gó - no go gauge type or is visual. Except in some minor instances, all our charts were of the fraction defective type.

The organization to handle this work was simple. It included, besides the Supervisor, a Technical Assistant who was familiar with Quality Control technique and the Quality Control observers. These last were girls who were chosen partially for their education,

partially because they were personable and could deal with higher supervision, and partially because they were already known to be observant. These girls were specially trained in statistical techniques of an elementary kind and also in the various processes they were called upon to observe. When fully trained, they were capable of operating without supervision, keeping the Quality Control charts up-to-date and pointing out, in each instance, the cause of a decrease in quality level. It was never considered necessary to have shift supervision over these observers.

or through which the molten T.N.T. is poured. T.N.T. has quite a large shrinkage factor on cooling. As a result, there is a very large tendency towards the formation of a shrinkage cavity in the casting below the solidified surface. The presence of such a cavity in the casting not only jeopardizes the correct functioning of the shell, but also may cause a premature explosion due to collapse of the casting and components into the cavity. In order to prevent the formation of the cavity in the casting itself, it is necessary to take various precautions during the pouring and

DEFECT HOURLY ACTION SHEET LINE DATE

QUALITY CONTROL OBSERVATION	QUALITY CONTROL ACTION	PERCENTAGE DEFECTIVE 0 5 10 15 20	PRODUCTION FOREMAN'S REASON	PRODUCTION ACTION
		9AM		
		10		
		11		
		12		
		1PM		
		2		
		3		
		4		
		5		
		6		
		7		
		8		
		9		
		10		
		11		
		12		
		1AM		
		2		
		3		
		4		
		5		
		6		
		7		
		8		

LINE SUPERINTENDENTS REMARKS

FIGURE 1

The first work that was undertaken by this section involved a rather tough problem concerned with the filling of 40MM. shell with T.N.T. The finished casting has a large cavity in the bottom to contain a tracer and a cavity which is not quite so large in the top which contains the fuse and exploding system. The space between the top of the first and the bottom of the second is quite small, say 3/4". These cavities are produced by formers over

cooling, the object being to raise the shrinkage cavity into the funnel former through which the molten T.N.T. is poured.

At the time Statistical Control was introduced on this operation, the percentage defective due to cavities in the casting varied anywhere from 10 to 40%. Such rejects could be rectified by removal of the casting to a point below the cavity. Within two months, the average percent defective

INDUSTRIAL QUALITY CONTROL

had been reduced to about 5%, but within another two months this average had increased slowly to about 10%. The reason for this was not too obvious at first, but was discovered by close questioning of the Quality Control observers. These observers had been marking the reasons for high points on their charts, but the production supervision had failed to take action in most case.

During the original two month period, action was taken because the foremen were not sure of how much authority these Quality Control observers had. However, it did not take them too long to discover that it was very difficult for higher supervision to enforce action on the basis of observations. We therefore devised what we call an action sheet, a copy of which is shown as Figure I. If you will look at the left hand column on this sheet, you will see the heading "observations". In this column, the Quality Control observers enter their reason for high points on the percentage defective charts. In the next column, under "action taken" is usually entered the phrase "notify foreman". In the centre column appears the percentage defective chart on an hourly basis. This chart is plotted vertically rather than in its usual horizontal position, and the percentage defective for each hour is marked as a horizontal bar extending from zero to the point representing that particular per cent. The three sigma control limits are marked on these charts at the beginning of the morning shift. In the next column is a space for the foreman's comment and, in the last column, the foreman is required to mark the action he has taken. The results of his action will, of course, show in the next few hours. So, this sheet in effect puts the foreman on record.

These action sheets are kept in triplicate, and they are kept for a twenty-four hour period starting at 8 each morning. Two of the copies arrive in the Line Superintendent's office at 9 for the previous twenty-four hours. One copy is sent to the Quality Control Superintendent. One of the two copies is kept in the Line Superintendent's office and the second one with his comment or explanation at the bottom, is forwarded to the General Superintendent of Production. If any matter shown on these sheets is not satisfactorily settled by the foreman or the Line Superintendent's comments, a decision is reached between the General Superintendent of Production and the General Superintendent of Quality Control.

These sheets have proved astoundingly effective in driving home to the foreman his responsibility for quality. Probably they are not necessary where this has already been accomplished, but I am sure that the Production Departments in our plants would be the first to object if we were to remove them on any operation.

The rejections for cavities in the 40 MM. casting now average about 2% which is considered to be a satisfactory mean.

There have been cases of lack of co-operation between Production and Quality Control, but one of the benefits of the Quality Control chart is that such a situation becomes quickly obvious through the variations appearing on the charts. In one most stubborn case in one of our plants, it was necessary to use a co-operative group of operators in order to prove to a recalcitrant foreman the effectiveness of Statistical Quality Control.

The last example which I thought might interest you, concerns the analysis of the laboratory results obtained on an explosive manufactured at the plant.

The Quality Control section had been charting the bulk densities of batches of this explosive for some time. These densities had shown more variation than could be laid to chance causes. Various changes in process were recommended without success, but finally one change involving the lowering of the paddle in a mixing pan was shown not only to have raised the mean bulk density, but to have narrowed the limits of variation.

The interesting part of this example reveals that production supervision charged with manufacture of this explosive reported lowering the paddle made no appreciable difference. Their erroneous conclusion was due to analyzing columns of figures. We analyzed charts. An explanation of the charts was sufficient to convince production of the desirability of the proposed corrective action.

I would like to acknowledge that much of our success in Statistical Control is due to your government extending the courtesy of the O.P.R.D. courses. We availed ourselves of this privilege and thus were able to introduce trained Quality Control men on short notice who were sufficiently familiar with their subject to train others. We have extended training in the plants to cover most of the supervision.

NEW DEVELOPMENTS

In this section of each issue is presented one or more new developments in the field of Quality Control

CONTROL CHARTS FOR NONSYMMETRICAL DISTRIBUTIONS

The September issue of Industrial Quality Control contained a preliminary statement of the problem of control when dealing with a nonsymmetrical distribution. The practical difficulty lies in the fact that both individual measurements and averages of subgroups tend to be out of control on an ordinary chart even though the product functions properly in its intended use. The trouble arises from the discrepancy between the actual variability pattern of a nonsymmetrical distribution and the assumption of symmetrical variability made in placing control limits on the ordinary chart. A lesser cause of distortion is the use of the arithmetic average with a nonsymmetrical distribution. In particular, with a logarithmic distribution such as was illustrated in the September issue the geometric average should be used and a measure of geometric dispersion. The computation of these measures is laborious and members of the quality staff would require special training in the manipulation of logarithms. To avoid this, the presentation which follows is dependent solely on graphic analysis.

TABLE I: MEASUREMENTS OF AN ELECTRICAL CHARACTERISTIC OF AN ELECTRONIC DEVICE: DAILY RECORD FOR THE WEEK OF OCT. 2, 1944 AND TOTAL FOR THE WEEK.

VALUE OF MEASUREMENT	DISTRIBUTION OF MEASUREMENTS						TOTAL	
	OCT 2	OCT 3	OCT 4	OCT 5	OCT 6	OCT 7	NO.	%
0 and less than .4	107	46	107	649	181	320	1410	42.2
.4 " " " .8	203	153	160	275	258	245	1294	38.8
.8 " " " 1.2	56	152	89	50	38	89	474	14.2
1.2 " " " 1.6	9	63	24	11	4	10	121	3.6
1.6 " " " 2.0	1	13	5	2	2	2	25	.8
2.0 " " " 2.4	1	4		1	1	1	8	.3
2.4 " " " 2.8		2			1		3	.1
TOTALS	377	433	385	988	485	667	3335	100.

Nonsymmetrical distributions apparently are more common than the write up in the September issue implied. Several have been supplied by members of the Society. Of these, two have been selected for presentation, but unfortunately both are war products and detailed information cannot be given concerning the characteristic measured.

The first one is an electrical characteristic of an electronic device. The data for tests made on six successive days are shown in Table I. On the fifth and seventh the maximum frequency falls in the first class interval and on the other four days in the second class interval. The distribution of the total tests during the week shows the pattern of this characteristic. Curve A of Figure I is a representation of this weekly total distribution with the usual type of base scale, while curve B is the same thing with a geometric base scale. The slope of the curve is quite different. If sufficient readings of small values of the characteristic were available, the B curve would be symmetrical. However, it is preferable to leave the example as it is, since many others will appear in this form.

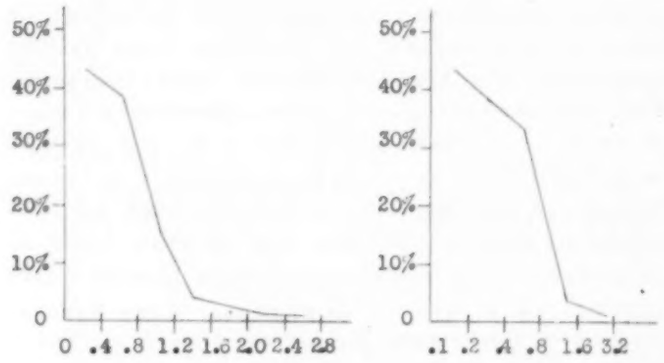

FIGURE I

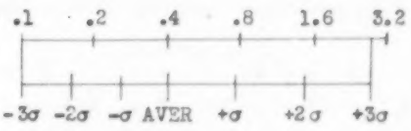

FIGURE II

Having encountered this type of distribution the Quality Control Engineer will find one of two possible situations: either the product functions in its intended use or it is suffering a heavy rejection rate. In either case it presumably will show out of control on an ordinary control chart. If rejections are common, the usual engineering procedure should be followed to adjust the average level, reduce the variability or both. Whatever adjustments are made at this stage should be aimed specifically at reduction of the rejection level to an economic minimum. An ordinary control chart will continue to be inadequate, but the trouble can now be allocated to the nature of the distribution.

Whether this situation is arrived at by process adjustment or exists at the point of initial investigation, the next step is the transfer to a type of control chart designed for representation of a nonsymmetrical distribution. The values of $\pm\ \sigma$, $\pm\ 2\ \sigma$ and $\pm\ 3\ \sigma$ can be obtained with sufficient accuracy for practical work from a scale such as that shown in Figure II. The top of this scale is transferred directly from the base line of curve B of Figure I. The range of these data between .1 and 2.8 has been found to give acceptable product. Therefore a chart set up with control limits at these values will be satisfactory. The first step is to locate on the scale the position of the geometric average (G). This is done by substituting in the approximate formula,

$$G = \sqrt{\bar{\bar{X}}^2 - \sigma^2} \qquad \bar{\bar{X}} > \sigma$$

For these data $\bar{\bar{X}} = .533$, $\sigma = .368$ and $G = .384$

This point is marked on the scale of Figure II and the distance from .384 to .1 is divided into 3 equal parts as indicated on the bottom scale. These are labeled $-\sigma$, -2σ, and -3σ, and the corresponding values are read from the upper scale. The same procedure is followed to the right of G. Thus are obtained the unequally spaced values of the standard deviation needed for a nonsymmetrical distribution. The readings are:

-3σ	.10	$+3\sigma$	2.80
-2σ	.16	$+2\sigma$	1.45
$-\sigma$	.23	$+\sigma$	.76

Critical readers will immediately recognize that an error has been introduced by reading the upper scale as though intermediate values between the scale divisions were equally spaced. The accurate method, of course, would be to locate these values of σ by the use of logarithms. The approximations used here are not detrimental to the practical use of the chart and have the advantage of avoiding techniques which may not be a part of the equipment of the average control chart operator.

The control chart is prepared in the form shown in Figure III with the values of the σ's in the positions indicated in relation to an ordinary vertical scale. This chart may appear to be quite unbalanced, but points can be expected to fall in the $\pm\ \sigma$, $\pm 2\sigma$, and $\pm 3\sigma$ bounds for a nonsymmetrical distribution in the same proportions as they would fall in the bands of equal width for a symmetrical distribution.

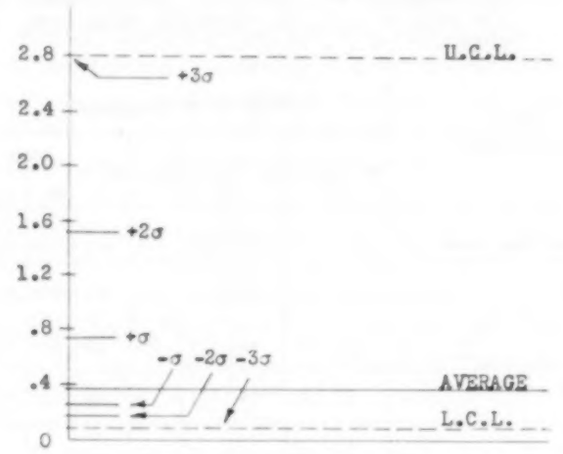

FIGURE III

This procedure has been set up for the plotting of individual measurements on the control chart. This would seem to be the preferable procedure for nonsymmetrical distributions. The corresponding development for averages of sub-groups appears to present problems which are beyond the scope of simple graphic solution. Perhaps readers of this article will elect to develop a solution of the problem of preparing control charts for averages and ranges of a nonsymmetrical distribution.

The second illustration is a distribution of measurements of concentration of the residue resulting from a chemical process. The data are shown in Table II. They differ in form from those of the previous illustration in that the left extension of the distribution is broken into classes with frequencies diminishing toward zero. As a result, the treat-

ment of this case is different in detail and slightly simpler than the preceding one.

The frequency curve is shown in Figure IV-A with an ordinary base scale, showing the nonsymmetrical character of the distribution. The same data are used for Figure IV-B with the base scale spaced in geometric progression. The symmetrical curve indicates the logarithmic character of the distribution.

The next step in the analysis of this process consists in determining whether it is producing at a satisfactory level. In this case the variability is somewhat excessive, but not so much so that preliminary adjustment of the process was deemed advisable. Accordingly we proceed to the determination of the geometric average of the distribution. The peak of the curve lies very nearly at .114 on the base scale and the curve is symmetrical geometrically about this point; .114 may therefore be taken as the geometric average. It should be noted that the formula, $G = \sqrt{\bar{X}^2 - \sigma^2}$ used in the first illustration, is not applicable here, because $\bar{X} < \sigma$.

TABLE II: MEASUREMENTS OF CONCENTRATION OF THE RESIDUE RESUETING FROM A CHEMICAL PROCESS: TWO DAY'S RECORD FROM A CONTINUOUS RON: DATA CLASSIFIED ARITHMETICALLY AND GEOMETRICALLY.

ARITHMETRIC DISTRIBUTION			GEOMETRIC DISTRIBUTION		
MEASURE OF CONCENTRATION	FREQUENCY NO.	FREQUENCY %	MEASURE OF CONCENTRATION	FREQUENCY NO.	FREQUENCY %
0 and less than .02	22	1.3	.01 and less than .015	1	.6
.02 " " " .03	10	6.4	.015 " " " .0225	2	1.3
.03 " " " .04	14	9.0	.0225 " " " .0338	9	5.8
.04 " " " .06	16	10.3	.0338 " " " .0507	18	11.6
.06 " " " .10	21	13.7	.0507 " " " .0760	20	12.9
.10 " " " .20	46	29.9	.076 " " " .114	26	16.8
.20 " " " .30	17	10.9	.114 " " " .171	25	16.2
.30 " " " .40	13	8.4	.171 " " " .256	20	12.9
.40 " " " .50	5	3.2	.256 " " " .384	18	11.6
.50 " " " .60	3	1.9	.384 " " " .575	8	5.2
.60 " " " .70	3	1.9	.575 " " " .863	5	3.2
.70 " " " .80	2	1.3	.863 " " " 1.294	2	1.3
.80 " " " 1.00	1	.6	1.294 " " " 1.941	1	.6
1.00 " " " 1.20	1	.6			
1.20 " " " 1.40	1	.6			
	155	100.		155	100.

The values of the sigmas can now be established from Figure V. The procedure is a duplicate of that explained in the previous illustration. Readers will notice that the range (.01 to 1.40) is not divided into 6 equal segments on the lower scale. The equal segments to the left of the average are slightly shorter than those to the right.

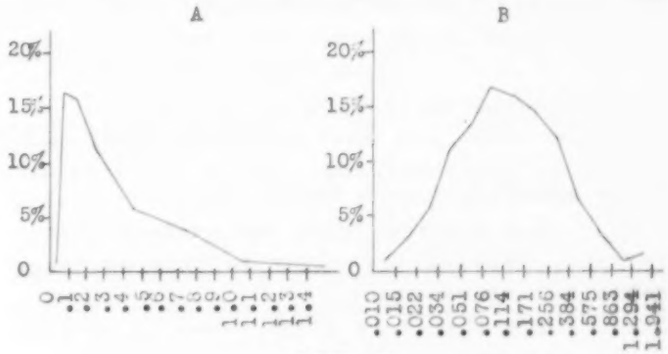

FIGURE IV

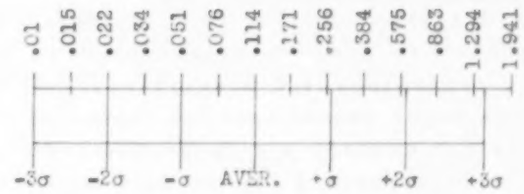

FIGURE V

Finally, the values on the upper scale, corresponding to the sigmas on the lower scale of Figure V, are transferred to the vertical scale of the control chart of Figure VI.

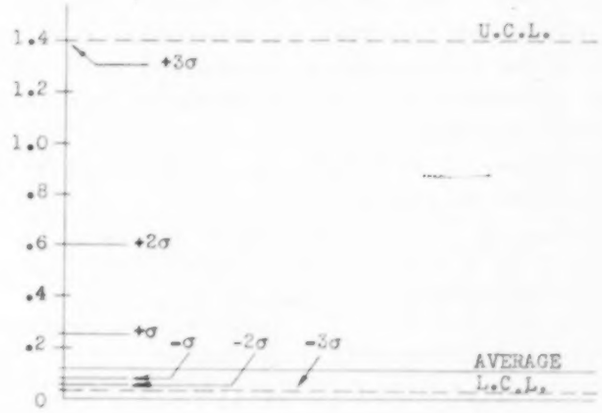

FIGURE VI

Figure III and VI are the control charts which would be used in the production areas to maintain control of these processes. Although small scales have been used in this article to save space, a fairly large chart is required in practice in order to make available to the tester a larger plotting area below the average. This will give a very large field above the average, but that is desirable because it is a correct representation of the way chance variability will occur in a distribution of this kind. The initial symptoms of a non-symmetrical distribution, referred in the September issue of Industrial Quality Control, was points out of control on an ordinary chart with no assignable cause. The form of chart developed in this article adjusts the control limits to the character of the distribution. Hence the interpretation of this chart parallels that of the ordinary chart. A point outside the control limit means that investigation should be made to discover a new cause of variability in the process. One point should be kept constantly in mind. This chart is designed for the control of individual measurements or readings. The adjustment of logarithmic control limits to accommodate averages of subgroups introduces complications that lie far beyond the scope of this article.

APPLIED QUALITY CONTROL *(Continued from Page 3)*

to be approached on a larger scale.

2.5 Provide talks for operators concerned - selling technique to them as their tool; get cooperation.

2.6 Institute plant class in statistical methods.

3. Plant-Wise Operating Level

3.1 Set up Quality Control Department in which there are men experienced in both process technology and statistical methods. This department should have functional responsibility for control and inspection methods; direct responsibility for product acceptance and coordination. The department manager should report to the plant manager.

3.2 Set up clinical class meetings on problem developments and new techniques. Make reports on dollar savings and quality improvements.

A fully grown quality control program will require technical and statistical training of its key personnel. Management should grant both scope and authority to the responsible department. It is fair to say that there are few better investments. Inspection data, like statistics, can be both misleading and revealing, and it takes a professional mind to grasp their real meaning. Unfortunately many are still oblivious to the potentialities of our processes.

ROCHESTER SOCIETY

Alfred L. Davis, President

As for the activities of our Society the following has occurred since "Industrial Quality Control" last went to press:

October - Joseph Manuele of Westinghouse did his usual fine job of presenting Quality Control as a thoroughly usable and practical tool of industry. The attendance for this meeting was 218.

Election of officers also took place with the following results:

President	Alfred L. Davis *Bausch and Lomb*
Vice-President	Halsey Kent, *Camera Works, Eastman*
Secretary-Treasurer	J.A. Tilton, *Delco Appliance Div. of General Motors*

November - The largest group of the year, 235, turned out to hear J. M. Juran, Assistant to the Administrator of the Foreign Economic Administration. Mr. Juran gave an excellent talk on the subject "Management Evaluates the Inspection Function". As was expected, Mr. Juran gave the group many new slants on management's interest in Quality Control.

We have also had the pleasure of having representatives from Ansco Company, Binghamton and Corning Glass Company, Corning, N.Y., join with us in these meetings.

December - The meeting of December 19th will be a panel discussion of control problems. On the panel will be representatives of Eastman, Kodak Park, Delco, Stromberg Carlson, and Colonial Radio.

A SIMPLIFIED METHOD OF COMPUTING CONTROL LIMITS FOR PER CENT DEFECTIVE

H. Reinhardt and E. D. Benson
Appliance Department
SYLVANIA ELECTRIC PRODUCTS INC.
Ipswich, Mass.

The following is a description of a simplfied method of computing control limits for per cent defective by means of the equation:

$$\text{Three sigma limits} = P \pm 3\sqrt{\frac{p(1-p)}{n}}\ 100$$

Where P = Average per cent defective

p = Average fraction defective

and n = Average number of units inspected.

The expression to the right of the $\pm$ sign may be written as follows:

$$\sqrt{(p' - p)} \times \frac{300}{\sqrt{n}}$$

If we let $A = \sqrt{p(1-p)}$ and $B = \frac{300}{\sqrt{n}}$

the above equation becomes:

$$\text{Three sigma limits} = P \pm A \times B$$

Values of A for various values of p, and values of B for various values of n, may be worked out and tabulated for the range of values normally encountered as in the accompanying tables. This makes possible a simplified procedure in the calculation of the limits which can be rapidly learned and accurately applied even by persons whose previous mathematical training is such that they would experience considerable difficulty with the use of curves or tables requiring interpolation.

The values in the tables have been spaced closely enough that interpolation is not necessary for the accuracy normally required in control chart work.

The procedure is further standardized and simplified by use of a specially prepared form, one section of which, is shown here in Figure I, as an illustration of this method of computing control limits. The directions supplied to the persons who use this form are given below:-

HOW TO COMPUTE THE CONTROL LIMITS

Contr-l limits should be computed at the end of each 15 day period in the following manner:

1. Total the "Number Inspected" and the "Number Defective" columns for all inspection positions.

2. Compute the average number inspected per day, n, by dividing the total inspected by 15.

3. Multiply the total defective by 100 and divide by the total inspected to obtain P, the average per cent defective. Enter this value of P in all three of the spaces indicated on the record sheet.

4. Using the value of n determined in (2), find the corresponding value of B from the table supplied, and enter it in the space indicated on the record sheet.

5. Using the value of P determined in (3), find the value of A from the table supplied and enter it in the space provided on record sheet.

6. Multiply A times B to obtain the product AB, and enter the results in the two spaces indicated on the record sheet, one by the + sign, and the other by the − sign.

7. Add the value of AB to P to obtain the upper control limits in the space provided in the one column, and subtract AB from P to obtain the lower limit in the next column.

FIGURE I

	INSPECTION STATION NO. 1		
DATE	NO. INSPECTED	NO. DEFECTIVE	% DEFECTIVE
7/10	1090	150	13.8
7/11	1174	152	12.9
7/12	1242	103	8.3
7/13	1379	87	6.3
7/14	1292	160	12.4
7/17	1309	158	12.1
7/18	1174	125	10.6
7/19	1460	146	10.0
7/20	1352	132	9.8
7/21	1370	96	7.0
7/24	1440	121	8.4
7/25	1320	139	10.5
7/26	1297	84	6.5
7/27	1354	121	8.9
7/28	1340	136	10.1
Sum.	19611	1910	
Ave.	n = 1307		P = 9.75
	B = 8.29		A = 0.296
P	− 9.75		9.75
AxB	+ 2.46		− 2.46
Limits	12.21		7.29
	Upper		Lower

INDUSTRIAL QUALITY CONTROL

TABLE "A"

P	A	P	A	P	A	P	A
0.1	0.0316	5.1	0.220	10.1	0.301	15.1	0.358
0.2	0.0447	5.2	0.222	10.2	0.303	15.2	0.359
0.3	0.0546	5.3	0.224	10.3	0.304	15.3	0.360
0.4	0.0631	5.4	0.226	10.4	0.305	15.4	0.361
0.5	0.0705	5.5	0.228	10.5	0.306	15.5	0.362
0.6	0.0772	5.6	0.230	10.6	0.308	15.6	0.363
0.7	0.0834	5.7	0.232	10.7	0.309	15.7	0.364
0.8	0.0890	5.8	0.234	10.8	0.310	15.8	0.365
0.9	0.0944	5.9	0.236	10.9	0.312	15.9	0.366
1.0	0.0995	6.0	0.237	11.0	0.313	16.0	0.367
1.1	0.105	6.1	0.239	11.1	0.314	16.1	0.368
1.2	0.110	6.2	0.241	11.2	0.315	16.2	0.369
1.3	0.114	6.3	0.243	11.3	0.316	16.3	0.370
1.4	0.118	6.4	0.244	11.4	0.318	16.4	0.371
1.5	0.123	6.5	0.246	11.5	0.319	16.5	0.372
1.6	0.127	6.6	0.248	11.6	0.320	16.6	0.372
1.7	0.130	6.7	0.250	11.7	0.322	16.7	0.373
1.8	0.134	6.8	0.252	11.8	0.323	16.8	0.374
1.9	0.137	6.9	0.254	11.9	0.324	16.9	0.375
2.0	0.140	7.0	0.255	12.0	0.325	17.0	0.376
2.1	0.143	7.1	0.257	12.1	0.326	17.1	0.377
2.2	0.146	7.2	0.258	12.2	0.327	17.2	0.378
2.3	0.150	7.3	0.260	12.3	0.328	17.3	0.378
2.4	0.153	7.4	0.261	12.4	0.329	17.4	0.379
2.5	0.156	7.5	0.263	12.5	0.331	17.5	0.380
2.6	0.159	7.6	0.264	12.6	0.332	17.6	0.381
2.7	0.162	7.7	0.266	12.7	0.333	17.7	0.381
2.8	0.165	7.8	0.267	12.8	0.334	17.8	0.382
2.9	0.168	7.9	0.269	12.9	0.335	17.9	0.383
3.0	0.171	8.0	0.271	13.0	0.336	18.0	0.384
3.1	0.173	8.1	0.273	13.1	0.337	18.1	0.385
3.2	0.175	8.2	0.274	13.2	0.338	18.2	0.386
3.3	0.177	8.3	0.276	13.3	0.339	18.3	0.387
3.4	0.180	8.4	0.277	13.4	0.340	18.4	0.387
3.5	0.182	8.5	0.279	13.5	0.341	18.5	0.388
3.6	0.185	8.6	0.280	13.6	0.343	18.6	0.389
3.7	0.187	8.7	0.282	13.7	0.344	18.7	0.389
3.8	0.190	8.8	0.283	13.8	0.345	18.8	0.390
3.9	0.193	8.9	0.285	13.9	0.346	18.9	0.391
4.0	0.196	9.0	0.286	14.0	0.347	19.0	0.392
4.1	0.198	9.1	0.287	14.1	0.348	19.1	0.393
4.2	0.200	9.2	0.289	14.2	0.349	19.2	0.394
4.3	0.202	9.3	0.290	14.3	0.350	19.3	0.394
4.4	0.204	9.4	0.292	14.4	0.351	19.4	0.395
4.5	0.206	9.5	0.293	14.5	0.352	19.5	0.396
4.6	0.208	9.6	0.294	14.6	0.353	19.6	0.397
4.7	0.210	9.7	0.296	14.7	0.354	19.7	0.397
4.8	0.213	9.8	0.297	14.8	0.355	19.8	0.398
4.9	0.216	9.9	0.299	14.9	0.356	19.9	0.399
5.0	0.218	10.0	0.300	15.0	0.357	20.0	0.400

INDUSTRIAL QUALITY CONTROL

TABLE FOR "B"

n	B	n	B	n	B
1	300.00	51	42.00	105	29.25
2	212.13	52	41.61	110	28.59
3	173.19	53	41.22	115	27.96
4	150.00	54	40.83	120	27.39
5	134.16	55	40.44	125	26.84
6	122.46	56	40.08	130	26.31
7	113.40	57	39.75	135	25.80
8	106.08	58	39.39	140	25.35
9	100.00	59	39.06	145	24.90
10	94.86	60	38.73	150	24.48
11	90.45	61	38.40	155	24.09
12	86.61	62	38.10	160	23.72
13	83.22	63	37.80	165	23.34
14	80.19	64	37.50	170	23.01
15	77.46	65	37.20	175	22.68
16	75.00	66	36.93	180	22.35
17	84.75	67	36.66	185	22.05
18	70.71	68	36.39	190	21.67
19	68.82	69	36.12	195	21.48
20	67.08	70	35.85	200	21.21
21	65.46	71	35.61	210	20.70
22	63.96	72	35.37	220	20.22
23	62.55	73	35.10	230	19.77
24	61.23	74	34.84	240	19.35
25	60.00	75	34.65	250	18.97
26	58.83	76	34.41	260	18.60
27	57.75	77	34.20	270	18.25
28	56.70	78	33.96	280	17.93
29	55.71	79	33.75	290	17.61
30	54.78	80	33.54	300	17.32
31	53.88	81	33.33	310	17.04
32	53.04	82	33.12	320	16.77
33	52.23	83	32.94	330	16.52
34	51.45	84	32.73	340	16.26
35	50.70	85	32.55	350	16.05
36	50.01	86	32.34	360	15.81
37	49.32	87	32.16	370	15.60
38	48.66	88	31.98	380	15.39
39	48.03	89	31.80	390	15.20
40	47.43	90	31.62	400	15.00
41	46.86	91	31.44	410	14.81
42	46.29	92	31.26	420	14.64
43	45.75	93	31.11	430	14.46
44	45.21	94	30.93	440	14.31
45	44.73	95	30.78	450	14.13
46	44.22				
46	44.22	96	30.60	460	13.98
47	43.77	97	30.45	470	13.83
48	43.29	98	30.30	480	13.68
49	42.87	99	30.15	490	13.55
50	42.42	100	30.00	500	13.42

INDUSTRIAL QUALITY CONTROL

TABLE FOR "B"

n	B	n	B	n	B
500	13.42	1000	9.48	1500	7.75
510	13.29	1010	9.43	1510	7.72
520	13.17	1020	9.39	1520	7.70
530	13.04	1030	9.34	1530	7.67
540	12.92	1040	9.30	1540	7.64
550	12.80	1050	9.25	1550	7.62
560	12.69	1060	9.21	1560	7.59
570	12.58	1070	9.17	1570	7.57
580	12.47	1080	9.13	1580	7.54
590	12.36	1090	9.09	1590	7.52
600	12.25	1100	9.05	1600	7.50
610	12.15	1110	9.01	1610	7.47
620	12.06	1120	8.97	1620	7.45
630	11.96	1130	8.93	1630	7.43
640	11.86	1140	8.89	1640	7.41
650	11.77	1150	8.85	1650	7.39
660	11.68	1160	8.81	1660	7.36
670	11.59	1170	8.77	1670	7.34
680	11.50	1180	8.73	1680	7.32
690	11.42	1190	8.70	1690	7.30
700	11.34	1200	8.66	1700	7.28
710	11.26	1210	8.62	1710	7.26
720	11.18	1220	8.59	1720	7.23
730	11.10	1230	8.55	1730	7.21
740	11.02	1240	8.52	1740	7.19
750	10.95	1250	8.48	1750	7.17
760	10.88	1260	8.45	1760	7.15
770	10.81	1270	8.42	1770	7.13
780	10.75	1280	8.39	1780	7.11
790	10.68	1290	8.35	1790	7.09
800	10.61	1300	8.32	1800	7.07
810	10.54	1310	8.29	1810	7.05
820	10.48	1320	8.26	1820	7.03
830	10.42	1330	8.22	1830	7.01
840	10.36	1340	8.19	1840	6.99
850	10.30	1350	8.16	1850	6.98
860	10.24	1360	8.13	1860	6.96
870	10.18	1370	8.10	1870	6.94
880	10.12	1380	8.08	1880	6.92
890	10.06	1390	8.05	1890	6.90
900	10.00	1400	8.02	1900	6.88
910	9.95	1410	7.99	1910	6.87
920	9.90	1420	7.96	1920	6.85
930	9.84	1430	7.93	1930	6.83
940	9.79	1440	7.90	1940	6.81
950	9.73	1450	7.88	1950	6.80
960	9.68	1460	7.85	1960	6.78
970	9.64	1470	7.82	1970	6.76
980	9.59	1480	7.80	1980	6.75
990	9.54	1490	7.77	1990	6.73
1000	9.48	1500	7.75	2000	6.71

BUFFALO MEETINGS

OCTOBER 9th

The third graduation dinner of the Society of Quality Control Engineers was held at the Markeen Hotel, October 9th. Some 75 members and guests were in attendance to honor 25 graduates of the 16 week course conducted by the University of Buffalo during the summer.

The speaker for the occasion was Dr. Douglas F. Brown, General Superintendent of Quality Control, Defense Industries Limited, Cherrier, Quebec. Dr. Brown gave a most enlightening presentation of the methods employed in introducing control procedures in an ammunition plant. This address is reproduced on preceding pages of this magazine.

NOVEMBER 27th

A technical and business session of the Society of Quality Control Engineers was held at the University of Buffalo, November 27th with George V. Herrold of Colonial Radio Corporation presiding. Some 80 members and guests were in attendance.

William B. Rupp of RCA, Harrison, New Jersey, gave a general story of Quality Control Activities in Northern New Jersey including some highlights from meetings of the Newark Society for Statistical Quality Control of which Mr. Rupp is Secretary.

J. R. Steen, Quality Control Coordinator of Sylvania Electric Products Corporation, Emporium, Pennsylvania presented a paper entitled: "Organization and Education Requirements for Industrial Quality Control". Mr. Steen stressed the importance of securing the cooperation of top management at the beginning of a control program, and concluded that the surest method of securing a sound development of the program is to offer training in the principles of quality control to supervisory personnel in production, inspection, and engineering.

Peter DiPaola of Curtiss-Wright Aeronautical Corporation, Kenmore Plant presented the story of the introduction and operation of a comprehensive control system in the Kenmore Plant. Mr. DiPaola emphasized the compromises that are necessary between basic methods and what is feasible in practice when dealing with the short runs of the machine shop and the diversified operations in receiving and assembly operations which characterize the airplane industry.

F. J. Haley of Colonial Radio Corporation summarized Colonial's First Year with Quality Control. Mr. Haley reviewed the main facts of his company's control system including a most arresting summary of accomplishments. The speaker told of the valuable aid given to the Engineering Department in determining proper specification limits and concluded his talk by stating the average reduction of the $\bar{p}$ level accumulated for the last year is 59%.

Following the technical session a brief business session was held which is reported in detail here because the Constitution of the Society of Quality Control Engineers requires that these actions be submitted to the membership in advance of the annual meeting. Actions taken:

1. Appointment of Committee to prepare a slate of officers for the year 1945. Messrs. Overholt, Colonial Radio, chairman; Hannon, Spencer Lens, and Letchworth, Barcalo were appointed.

2. The Executive Board proposed Amendment I to the Constitution to be acted upon at the annual meeting in January, 1945. The text of the amendment appears on page twenty. This amendment is proposed as a means of securing continuity of management of the affairs of the Society. With the publication of Industrial Quality Control the Society management is required from time to time to make policy decisions affecting future development which must be consistent with past action and which involve points of view that are known only to past Board members.

3. Motion made and passed to instruct the Nominating Committee to prepare a slate of officers in accord with the requirements of the amendment in case it is adopted by the Society, and also to prepare a slate of officers in accord with the present Constitution in case the amendment is rejected.

4. Martin A. Brumbaugh made a brief statement of the present status of our magazine, Industrial Quality Control. He stressed the fact that Buffalo support of the magazine is inadequate compared with its wide acceptance throughout the country.

5. The Nominating Committee met immediately after the general meeting and voted to propose the following eight members for election to the Executive Board in case the amendment to the Constitution is adopted:

Mr. Kenneth Conrad	Dupont Rayon
Mr. Peter DiPaola	Curtiss-Wright
Mr. R. A. Funk	Spencer Lens

(Continued on Page 20)

INDUSTRIAL QUALITY CONTROL

CURRENT PUBLICATIONS AND BIBLIOGRAPHY

A page of each issue of the Journal is devoted to brief reviews of articles on Statistical Quality Control appearing in current publications. Earlier issues of the Journal contain bibliographies of materials published in former years. The purpose is to provide readers with a permanent reference list. In compiling this historical list omissions are inevitable. Assistance from readers by supplying missing references will be appreciated.

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REVIEWS

AERO DIGEST

The September 15 issue of Aero Digest contains an article on the use of control procedure in the Curtiss-Wright, Buffalo Plant by Vernon Grom and Martin A. Brumbaugh. Features of the article are the form of organization of the Quality Division, the variation in types of techniques used in receiving, fabrication, and assembly, and the illustrations of results obtained.

THE GLASS INDUSTRY

The October issue of The Glass Industry contains a most instructive article by Joseph Manuele of Westinghouse Electric and Manufacturing Company. An article by Mr. Manuele invariability marks a milestone in the development of quality control knowledge and this one conforms to the tradition. The approach, the content, the illustrations, the point of view, the lucid style make this article a "must" for neophytes as well as experienced operators. Features are: (1) the practical approach to the principles of the Frequency Distribution and their application in detecting assignable causes of variability; (2) the explanation of the method of establishing the tool-wear chart and the illustration of the use of a diagonal average line with accompanying bands of variability; (3) the discussion of the advantages and limitations of patrol inspection and the methods applicable to different types of operation.

JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

The September issue of the Journal of the American Statistical Association contains an article by Edward M. Schrock, entitled "Matters of Misconception Concerning the Quality Control Chart." Mr. Schrock has been connected with the Ordnance Research Center at Aberdeen Proving Ground since the beginning of the war, and this is the story of the use of control chart technique in acceptance testing of tank armor.

Manufacturers of armor plate have raised many questions concerning the interpretation of the charts particularly in connection with rejected samples and criticisms from the Proving Ground where samples indicated an uncontrolled manufacturing process. The article is written in the form of a series of questions and answers. The answers give the basic principles of control chart operation and interpretation. The value of this article is not confined to producers of armor plate, nor to steel producers.

ELECTRONICS

The November issue of Electronics contains an article "Quality Engineering in Tube Manufacture" by Eugene Goddess, Special Products Engineer, North American Philips Company, Inc. The article deals with the testing of random samples to determine if production deviates from quality standards for dynamic performance tests, life test, mechanical tests, and appearance tests. This is the first of three articles.

NOTES

Charles H. Wing, President of The Society of Quality Control Engineers resigned from the research staff of National Gypsum Company to accept a position as Methods Engineer with the Link-Belt Company of Philadelphia.

A. G. Sawyer has resigned from the inspection staff of the Army Air Force to accept a position as Training Coordinator in the Subcontract Department of Curtiss-Wright Aeronautical Corporation.

James H. Munger, Statistical Quality Control Manager at Bell Aircraft Corporation, and author of the feature article in the September issue of Industrial Quality Control, has resigned from Bell to accept a position as Methods Engineer with B. F. Goodrich Corporation at Akron, Ohio.

Ralph Wareham, Quality Manager of General Electric Company with headquarters at Schenectady, visited the Company's Buffalo plant recently in connection with the control program now underway at the plant.

The November issue of the Bulletin of the American Statistical Association contains a notice of the beginning of publication of Industrial Quality Control and a summary of the contents of the July and September issues.

Walter Weiss, Quality Control Engineer of the Tube Plant of Sylvania Electric Products Corporation at Emporium has come through a two months illness and has returned to work.

BUFFALO MEETINGS (Continued from Page 17)

Mr. G. J. Letchworth	Barcalo
Mr. Joseph Mitchell	Bell
Mr. A. G. Sawyer	Curtiss-Wright
Mr. A. J. Winterhalter	Colonial Radio
Mr. Jacob Zook	Lehigh Cement

The Nominating Committee proposes that the entire election be held by a single ballot. Each member shall vote for six members of the Executive Committee. The two nominees receiving the greatest number of votes are to be considered elected to three year terms, the two in third and fourth positions to be considered elected to two year terms, and the two in fifth and sixth positions to be considered elected to one year terms. In case of a tie or ties a run-off vote shall be held

In case the amendment is rejected, the Nominating Committee is prepared to nominate officers in accord with the existing form of the Constitution. This alternate slate of officers is not published for obvious reasons.

AMENDMENT TO THE CONSTITUTION

The following, known as Amendment I to the Constitution of the Society will be acted upon at the Annual Meeting.

1. Delete from Article III, Section I the phrase: "and these along with the retiring President shall constitute the Executive Board."

2. Replace by:

The Executive Board shall consist of the officers of the previous year and six members elected by the Society. After 1945, two members will be elected to the Executive Board by the Society each year at its annual meeting to serve for a period of three years. At the annual meeting in January, 1945 the Society shall elect a complete Executive Board of six members, two to serve for one year, two to serve for two years, two to serve for three years. Within two weeks of the annual meeting, the President for the preceeding year shall convene the new Executive Board. At this meeting the Executive Board shall elect from its members the officers of the Society for the current year. In case an officer resigns his position, the Executive Board shall elect his successor from its members. The Executive Board, if necessary, may appoint new member(s) to replace member(s) who have resigned; but, in all cases, such appointment(s) run only until the next annual election at which time the Society shall elect a member(s) to the Executive Board to fill the unexpired term(s). The past presidents of the Society of Quality Control Engineers become permanent honorary members of the Executive Board in addition to the members previously stated.

CHAMBER OF COMMERCE

The Chamber of Commerce invites Quality Control Engineers to attend a luncheon meeting January 15. Joseph Manuele, Westinghouse Electric and Manufacturing, will speak on Quality Control. Detailed arrangements by mail later.

ANNUAL MEETING SQCE

The Society's annual meeting to elect officers will be held 7:45 PM January 15, in Room 301, Crosby Hall, University of Buffalo. Guest speaker will be Joseph Manuele, Quality Control Manager of Westinghouse.

INDUSTRIAL QUALITY CONTROL

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Buffalo 14, New York

THE SOCIETY OF QUALITY CONTROL ENGINEERS

PRESIDENT:	Charles H. Wing	National Gypsum Company
VICE PRESIDENT:	Martin A. Brumbaugh	University of Buffalo
SECRETARY:	Vernon Grom	Curtiss-Wright Corporation
TREASURER:	George V. Herrold	Colonial Radio Corporation